TRANSPORT OF DISSOLVED ORGANIC PHOSPHORUS (DOP) FROM SOIL TO SURFACE WATER ON DIFFERENT LAND USES

Verheyen D.[1], Van Gaelen N.[1], Ronchi B.[1], Vandevenne F.[2], Govers G.[1], Merckx R.[1], Batelaan O.[1, 3, 4], Struyf E.[2] and Diels J.[1]

[1]KU Leuven, Department of Earth and Environmental Sciences, Leuven, Belgium
[2]University of Antwerp, Department of Biology, Antwerp, Belgium
[3]Vrije Universiteit Brussel, Department of Hydrology and Hydraulic Engineering, Brussels, Belgium
[4]Flinders University, School of the Environment, Adelaide, Australia

dries.verheyen@ees.kuleuven.be

While it is well known that agricultural activities may lead to significant increases of P loading of surface waters, the pathways through which P and in particular dissolved organic phosphorus (DOP) is transferred from the land to the river are less well understood. It was recently found that DOP is mostly bio-available to algae and hence high DOP concentrations may impair surface water quality. We studied three headwater catchments (30 – 300 ha), all located in Belgium but having different land uses (forest, arable land, grassland). We monitored different fractions of dissolved (<0.45 μm) phosphorus (P) in the river and in soil- and groundwater from January 2011 onwards in order to gain a better understanding of how land use changes may affect both DOP fluxes and pathways.

In general, the fraction of DOP concentration in the stream samples was low to negligible, but during peak flows after a dry period, the concentration of DOP rose to a significant level. In the agricultural catchment (arable land) DOP accounted for up to 10% of the total dissolved P load in the stream during runoff peaks. This is important as discharge peaks can transport a great amount of P (15 g P ha^{-1}) in a short period of time from the soil to the surface water.

In the forested catchment there was a clear difference in total P concentration between summer and winter. In winter the concentrations were low (<0.2 mg L^{-1}), even during runoff peaks. In summer, concentrations of total P could rise up to 0.6 mg L^{-1} in the baseflow. The rise in P concentration in the baseflow in summer can only be attributed to in-river processes, because no hydrologic pathway of P reaching the river can explain this particular rise in concentration. A hypothesis is that the breakdown of leaf litter or temperature driven microbial activity can be accounted for this rise.

In the grassland catchment the concentration of P was always low. During runoff peaks DOP concentrations rose slightly in comparison to the baseflow values. The concentrations of orthophosphate, colloidal P and DOP were found to rise together. This means that the water that was following a faster pathway was enriched in DOP and other P fractions in comparison to the baseflow. On a yearly basis, a total dissolved P loss of 1.3, 70.5 and 223.9 g P ha^{-1} is lost from the forested, grassland and agricultural catchment respectively.